

## **Master of Vocation (Medical Laboratory Technology)**

### **M. Voc. (MLT) Pathology- scheme and syllabus**

#### **Scope and Objective**

Post Graduate skill developing programme in Medical Laboratory Technology – Pathology gives Opportunity for specialized study in the field of Laboratory Technology for B.Voc. (MLT) Graduates. Candidates who successfully complete M.Voc. (MLT) course may obtain jobs as

- Specialized technologist in Pathology or supervisors of clinical laboratories in Hospitals.
- Laboratory scientists in Biomedical and research institutes.
- Teachers in training institutes of Medical Laboratory Technology.
- Utilize or apply the concepts, theories and principles of laboratory science.
- Demonstrate the ability to plan an effect the change in laboratory practice and Health care delivery system.
- Establish collaborative relationship with members of other disciplines.
- Demonstrate interest in continued learning and research for personal and Professional advancement.

#### **Eligibility for admission**

(a) Candidates who have passed the BMLT degree of any of the Universities

#### **Duration of the program**

Course of study including thesis work shall be for a period of two years.

- **Job Prospects:** The Medical Laboratory Technologists/ technician may be assigned to a specialized area of work in a large medical lab. In small labs, they may perform a variety of tests or all areas of lab work. They can also work as laboratory manager/ consultant/ supervisor, health care administrator, hospital outreach

coordinator, laboratory information system analyst/ consultant, educational consultant/ coordinator/ director, health and safety officer etc.

## M.Voc. (MLT) Syllabus

### Year 1 (Degree)

<b>I Semester</b>				
<b>S.No.</b>	<b>Course Code</b>	<b>Subject</b>	<b>Content Type</b>	<b>Credit</b>
1	<b>MVMLT-101</b>	Business Communication	<b>Gen</b>	
2	MVMLT-102	Human Anatomy & Physiology	Gen	3
3	MVMLT-103	Clinical Biochemistry	Gen	3
4	MVMLT-104	Hematology & Clinical Pathology	Skill	4
5	MVMLT-105	Bio-statistics	Skill	5
6	MVMLT-106	Clinical Microbiology	Skill	4
7	<b>MVMLTP-1</b>	<b>Vocational Practical</b>	<b>Skill</b>	<b>18</b>

<b>II Semester</b>				
<b>S.No.</b>	<b>Course Code</b>	<b>Subject</b>	<b>Content Type</b>	<b>Credit</b>
1	MVMLT-201	Physiology & Nutrition	Skill	4
2	MVMLT-202	Immunology, Molecular Biology	Skill	7
3	MVMLT-203	Laboratory Principles, Laboratory Techniques	Skill	5
4	MVMLT-204	Mycology, Virology, and Parasitology	Skill	4
5	MVMLT-204	Advance Instrumentation & Maintenance	Skill	4
6	MVMLT-205	Research Methodology	Gen	6
5	<b>MVMLTP-2</b>	<b>Vocational Practical</b>	<b>Skill</b>	<b>18</b>

**Master of Vocation (Medical laboratory technology)**

**M. Voc. (MLT) Syllabus  
Year 2 (Degree)**

<b>III Semester</b>				
<b>S.No.</b>	<b>Course Code</b>	<b>Subject</b>	<b>Content Type</b>	<b>Credit</b>
1	MVMLT-301	Systematic Bacteriology, Applied Microbiology & Immunology	Skill	6
2	MVMLT-302	Blood Transfusion & Immune hematology	Skill	5
3	MVMLT-303	Histopathology	Skill	4
4	MVMLT-304	Laboratory Management	Skill	3
5	MVMLT-305	Corporate Communication	Gen	4
6	MVMLTP-3	Vocational Practical	Skill	13

<b>IV Semester</b>				
<b>S.No.</b>	<b>Course Code</b>	<b>Subject</b>	<b>Content Type</b>	<b>Credit</b>
1	MVMLT-401	Basic Cellular Pathology & Allied Technology	Gen	3
2	MVMLT-402	Hematology & Clinical Pathology	Skill	3
3	MVMLT-403	Anatomy & Histotechnology	Skill	4
4	MVMLT-404	Mycology, Virology, and Parasitology	Gen	3
5	MVMLTP-4	Vocational Practical	Skill	13

*Master of Vocation (Medical  
Laboratory Technology)*

**M. Voc. (MLT)**

**MASTER OF VOCATION (Medical Laboratory  
Technology)**

**CONTENTS**

**Master of Vocation (Medical Lab Technology (Pathology)) M. Voc. 1<sup>st</sup>  
YEAR (Sem I)**

1. Human Anatomy & Physiology
2. Clinical Biochemistry
3. Clinical Pathology
4. Clinical Microbiology

**Practical**

1. Human Anatomy & Physiology
2. Clinical Biochemistry
3. Clinical Pathology
4. Clinical Microbiology

**Master of Vocation (Medical Lab Technology (Pathology)) M. Voc. 1<sup>st</sup>  
YEAR (Sem II)**

1. Physiology & Nutrition
2. Biostatistics & Hospital Management
3. Clinical Hematology
4. Advance Instrumentation & Maintenance

**Practical**

1. Physiology & Nutrition
2. Clinical Hematology
3. Advance instrumentation & Maintenance

**Master of Vocation (Medical Lab Technology (Pathology)) M. Voc.  
2<sup>nd</sup> YEAR (Sem III)**

1. Lab Management
2. Blood Transfusion & immune hematology
3. Histopathology
4. Diagnostic Microbiology

**Practical**

1. Blood Transfusion & Immunohematology
2. Histopathology
3. Diagnostic Microbiology

**Master of Vocation (Medical Lab Technology (Pathology)) M. Voc.  
2<sup>nd</sup> YEAR (Sem IV)**

1. Basic Cellular Pathology & Allied Technology
2. Hematology & Clinical Pathology
3. Anatomy & His to Technology
4. Pathology & cytology Technology Dissertation (Pathology) & Viva

**Practical**

1. Hematology & Clinical Pathology
2. Anatomy & His to Technology
3. Pathology & Cytology Technology

## M. Voc. M.L.T (PATHOLOGY) 1<sup>st</sup> YEAR (Sem I)

### PAPER:- 1 HUMAN ANATOMY & PHYSIOLOGY

#### Paramedical Course - Masters Anatomy

#### *Syllabus:*

#### UNIT-1

**Introduction:** Overview of the structure organization of the human body; anatomical terminology of positions & locations, planes.

**Cell:** Cell morphology and diversity; introduction to ultra structure and function of cell organelles.

**Skeletal Muscles:** Major skeletal muscles of the head, neck, thorax, abdomen and upper and lower limbs.

**General Osteology:** General morphology of bones; structural classification of bones, development and growth of skeletal tissue and bones.

**General Astrology:** Structural and functional classification of joints; general morphology of a synovial joint and associated structures; movements made available by synovial joints.

**Detailed Osteology and Astrology Practical:** Naming and identification of osteological features of individual human bones; Bones of Upper limbs – Clavicle, Scapula, Humerus, Radius, Ulna; Lower limbs – Femur, Hip bones, Sacrum, Tibia, Fibula, Ribs, Sternum Vertebral Column. Naming, identification and application of classification to the major joints of the human body; examples of variability in the human skeleton.

## UNIT-2

**Cardiovascular System:** Macroscopic features, function and location of the adult and the location of major arteries and veins; macroscopic features of blood vessels including arteries, veins and capillaries; morphological features of the cellular components of blood.

**Lymphatic System:** Macroscopic features, major function and location of the lymphatic vascular structures, lymph nodes, tonsils and other mucosa-associated lymphatic tissue, spleen and thymus; microscopic anatomy of lymph nodes.

**Nervous System:** Macroscopic features and major functions of the brain brief structure, location & function of cerebrum, cerebellum & brain stem and spinal cord; morphological features and major function of the contents of the peripheral nervous system and autonomic nervous system.

**Respiratory System:** Macroscopic features and major functions of the nasal cavity, paranasal sinuses, pharynx, larynx, trachea, bronchi, lungs and thoracic wall including the thoracoabdominal diaphragm.

**Digestive System:** Macroscopic features and major functions of the mouth, salivary glands, pharynx, oesophagus, stomach, small and large intestines, liver pancreas, biliary system and peritoneal cavity.

## UNIT-3

**Urinary System:** Macroscopic features, major functions and location of the kidneys, ureters, urinary bladder and the urethra.

**Endocrine System:** Macroscopic features, location and basic function of the hypothalamus, pituitary gland, thyroid gland, parathyroid glands, suprarenal glands, pineal gland and organs with a minor endocrine function.



**Male Reproductive System:** Macroscopic features, Major functions and location of the scrotum, testes, epididymis, ductus deferens, inguinal canal, seminal vesicles, prostate gland, bulbourethral gland and penis.

**Female Reproductive System:** Macroscopic features, major functions and location of the ovaries, uterine tubes, uterus, vagina and external genitalia.

**Special Senses:** Macroscopic features and major functions of the contents of the orbital cavity, the eyeball, lacrimal apparatus, and external, middle and internal ear.

## **UNIT-4**

**Upper Limb:** Relevant osteology; detailed plain radiographic anatomy of skeletally mature individuals.

**Head and Neck:** Relevant osteology of the skull and cervical vertebrae; surface anatomy, lymphatics major blood vessels and nerves of the head and neck; regional anatomy of the brain and its meninges.

## **UNIT-5**

**Histology:** macroscopic and microscopic studies of epithelial tissue, general connective tissue, cartilaginous tissue, bone tissue, muscle tissue, nervous tissue and the integument; major functional advantages of each tissue type.

### **Anatomy Practical:**

- Demonstration of bones identification and side determination upper limb-clavicle, scapula, humerus, radius, ulna, lower limb-femur, Hip bone, Tibia, Fibula, Vertebral Column, Ribs, Sternum, Sacrum
- Demonstration of heart.
- Demonstration of different parts of respiratory system and normal X-rays- lungs.

- Demonstration of the part of digestive system and normal X-rays- stomach, small intestine, large intestine, liver.
- Embalming of human cadavers for teaching purposes & social/ funeral embalming.
- Surface anatomy on cadaver.
- Demonstration of major vessels of the body-Aorta, subclavian, carotid, brachial, radial, ulnar, femoral, renal.
- Demonstration of bones & joints of the limb in normal X-ray.
- Demonstration of major muscles of the body-limbs, head & neck.
- Demonstration of other organs—spleen, testis, uterus.
- Histology-General epithelium, connective tissue, gland, bone, cartilage lymphoid tissue

Systemic-Lung, Esophagus, Stomach, Small Intestine, Pancreas, Liver, Kidney, Pituitary Gland, Thyroid, Testis, Ovary.

## **PARAMEDICAL SYLLABUS – PHYSIOLOGY (M.Sc.)**

**General Physiology:** Cell: Structure and function of a cell, Transport across the cell membrane, Passive Transport: Diffusion (Simple and Facilitated), Osmosis (Osmotic pressure, Tonicity), Active transport: Primary ( $\text{Na}^+\text{K}^+$  ATPase), Secondary, Carrier type (Uniporters, Symporters, Antiporters), Vesicular (Endocytosis and Exocytosis), Tissues: Definition and classification (Epithelial, Connective, Muscular, Nervous), Body water and body fluids: Distribution of total body water, Ionic composition of body fluids, Concept of pH and  $\text{H}^+$  concentration. The Membrane Potentials: Resting membrane potentials (Genesis & function), Action Potential

**Blood: Composition** and functions of blood, Hemoglobin (Normal values and time), Blood Cells: RBC<sub>s</sub>, WBC<sub>s</sub>, Platelets (Development, structure and functions), Coagulation of blood and bleeding disorders, Haemophilia, Purpura, Blood groups (ABO, Rh) Uses, Lymphoid tissues (types) and immunity, Immune system (Natural and Acquired), Applied: Anaemia (Types), Jaundice, Hemophilia

**Gastrointestinal Tract:** Organization of structure of GIT, Functions of digestive system, Innervation of GIT (Enteric Nervous System). Mouth (Oral Cavity): Boundaries, Tongue, Teeth, Composition and functions of saliva, Mastication (chewing), Swallowing (Deglutition) Stages. Stomach: Structure, Functions of stomach and innervation, Composition and functions of gastric juice, Regulation of secretion of gastric juice, Gastric motility and emptying. Pancreas: Structure, Nerve supply, , Composition, functions and regulation of secretion of pancreatic juice. Liver: Structure, Functions and Liver function tests Bile: Composition, functions and control of secretion. Gall Bladder: Functions of gall bladder. Small Intestine: Intestine juice, Digestion and movements. Large Intestine: Structure, movements, absorption and secretion, dietary fibers. Digestion and absorption in GIT: Digestion and absorption of carbohydrates, lipids and proteins. Food and nutrition: constituents of a normal diet, Balanced diet, Applied aspect (Deficiency diseases, Kwashiorkar, Marasmus)

**Respiratory System:** Structure and functions of respiratory system, Air Passages: Nose and nasal cavity, pharynx, larynx, tracheobronchial tree, lungs, respiratory membrane, pleura, Properties of gases: Partial Pressure, composition of dry air, Functions of respiratory system: Lung defense mechanism and pulmonary circulation. Mechanics of respiration: Mechanism of breathing (Inspiration and Expiration), Alveolar Surface Tension (Actions of surfactant), Alveolar Ventilation: Dead space (Anatomical and Physiological), Diffusion capacity of lungs (Clinical Significance), Lung volumes and capacities (Static: Tidal Volume, Residual Volume, Vital Capacity, Total Lung capacity; Dynamic: FEV<sub>1</sub>, FEV<sub>2</sub>, FEV<sub>3</sub>, Minute/Pulmonary Ventilation, Maximum Voluntary Ventilation). Transport of gases: Oxygen transport [Carriage of oxygen in blood; Dissolved form & combined with hemoglobin, Carriage of oxygen in the body; In tissues (At rest and during exercise), In lungs]. Carbon-di-oxide transport [Carriage of Carbon-di-oxide in blood; In dissolved form, carbamino form (In plasma and RBC<sub>s</sub>), as bicarbonate, Carriage of

Carbon-dioxide in lungs], Oxygen hemoglobin dissociation curve (Shift to right & Shift to left). Regulation of respiration: Nervous Regulation of respiration [Automatic control via Medullary and Pontine Respiratory centers, Voluntary control of respiration], Genesis of respiration (Inspiration and Expiration), Factors affecting respiration [Chemical and non-chemical stimuli], Chemical Regulation of respiration [Peripheral chemoreceptors (Carotid bodies and Aortic bodies) and Central (Medullary) chemoreceptors ]. Physio clinical aspects: Dyspnea, Apnea, Hypoxia

**Cardiovascular System:** General Cardiac chambers (Valves in the heart, Heart sounds, Pacemaker tissue of the heart), Properties of Cardiac Muscle, Cardiac Cycle, Electrocardiogram (ECG), Circulation: Functions, Pressure changes in vascular system, Organization and functions of vascular system, Distribution of major vessels in the body, Lymphatic system, Regulation of cardiovascular system:, Local (Basic Myogenic tone), Systemic: Chemical, Neural (Autonomic and medullary; Baroreceptors and Chemoreceptors) Heart Rate: Definition, Factors affecting HR and it's control, Cardiac Output: Definition, Distribution and control, Arterial Blood Pressure: Definition, factors affecting and regulation

**Excretory System:** Anatomy and Physiology of Urinary System, Kidney: Structure, Organization and functions of Glomerulus, Glomerular membrane, Blood supply Functions of kidney: Formation of urine, Regulation of water balance, Regulation of electrolyte balance, Regulation of acid-base balance, Endocrine functions of kidney, Urinary Passages: Ureters, Urinary Bladder (Structure and function, Higher control of micturation )

**Endocrine System:** Definitions, Control (Neural and endocrine), Characteristics of hormones, Pituitary Gland: Physiological anatomy (Anterior, intermediate and posterior lobe), Anterior Pituitary – Six Hormones (GH, PRL, TSH, ACTH, LH, FSH, Growth Hormone (GH): Control and actions, Applied (Gigantism, Acromegaly, Dwarfism),

Prolactin (PRL): Control and actions of PRL, Posterior Pituitary, ADH (Anti diuretic hormone): Control of ADH secretion, Actions of ADH, Applied, Oxytocin: Actions and Control of oxytocin secretion, Intermediate lobe of Pituitary , MSH (Melanocyte stimulating hormone), Thyroid Gland: Physiological anatomy, Types of hormones (T3 and T4), Regulation of thyroid secretion, Actions of thyroid hormone: Calorigenic , On carbohydrate metabolism, On lipid metabolism, On growth and development, Effect on nervous system, Applied (Goiter, Hypothyroidism, Hyperthyroidism), Parathyroid, Calcitonin and Vitamin-D: Role of calcium in metabolic processes, Distribution, Absorption and fate of calcium in the body, Hormones regulating calcium metabolism (Vitamin-D, PTH, Calcitonin), Applied (Rickets, Osteomalacia & Adult Rickets, Hyperparathyroidism), Adrenal Cortex: Physiological Anatomy of adrenal gland, Regulation of glucocorticoid secretion, Actions of glucocorticoids, Cushing's Syndrome, Mineral corticoids (Aldosterone, Actions of aldosterone, Regulation of aldosterone secretion, Addison's Disease), Sex Hormones, Adrenal Medulla: Physiological Anatomy, Actions of catecholamine's, Actions (CVS, carbohydrate metabolism, lipid metabolism, BMR, CNS, Eyes, Urinary bladder, skin), Pancreas: Physiological Anatomy, Glucagon, Insulin (Actions), Applied (Diabetes Mellitus; Causes, Signs and symptoms), Thymus and Pineal Gland: Thymus: Functions, immunological role of thymus, Pineal gland: General features, Functions, control

**Reproductive System:** Physiology of reproduction: Sex determination and sex differentiation, Puberty: Control of onset and stages, reproductive hormones; Gonadotropin (FSH & LH), Male Reproductive System: Testis: Structure and functions, Spermatogenesis, Structure of the sperm, Seminal tract and related glands, supporting structure, seminal fluid (semen), Endocrine functions of testis (Testosterone, Control of testicular activity) Female Reproductive System, Female reproductive tract: Uterus and related structures, ovaries, ovarian hormones (Estrogen, Progesterone and Relax in) , Female Sexual Cycle: Changes in the ovaries and uterus (Menstrual cycle), Vagina and gonadotropin secretion Contraceptive measures

**Central Nervous System:** Organization and functions of nervous system Brain: Cerebral Hemisphere (Cerebrum), Basal Ganglia, Thalamus, Hypothalamus Brain stem: Midbrain, Pons, Medulla, Reticular formation, Cerebellum Spinal Cord: Structure and functions, Ascending (Sensory) tracts, Motor (Descending) tracts Cerebrospinal Fluid

Peripheral Nervous system, Somatic Nervous System: Spinal nerves, Reflexes, Mono and Polysynaptic reflexes, Cranial nerves, Autonomic Nervous system (ANS): Sympathetic and Parasympathetic

**Special Senses:** The Smell: Olfactory receptors, Olfactory pathway, Physiology of olfaction, The Taste: Taste Receptors (Taste buds), Taste Pathway, Physiology of taste The Ear: Physiological Anatomy (External ear, Middle Ear, Inner ear, Cochlea), Physical Properties of sound, Mechanism of hearing, The Eye: Physiological Anatomy (Sclera, Choroid, Retina, Crystalline lens, photoreceptors), Visual Pathway, Image forming mechanism of eye, Visual Acuity, Visual reflexes, Accommodation, Defects of image forming mechanisms, Lacrimal Apparatus (Lacrimal gland, Lacrimal canaliculi, nasolacrimal duct, tears or Lacrimal fluid)

**Skin and Temperature:** Structure and function of skin, Temperature Regulation

## **Practical**

Haemoglobinometry

- White Blood Cell count
- Red Blood Cell count
- Determination of Blood Groups
- Leishman's staining and Differential WBC count

- Determination of packed cell Volume
- Erythrocyte sedimentation rate [ESR]
- Calculation of Blood indices
- Determination of Clotting Time, Bleeding Time

## **PAPER:- 2 CLINICAL BIOCHEMISTRY**

### **Syllabus**

#### **1<sup>ST</sup> YEAR:**

- 1) **Cell and Membrane:** Basic structure and function of the cell. Structure of the cell membrane. Functions of the cell membrane Transport through the cell membrane: active, passive, facilitated. Membrane proteins and functions.
- 2) **Chemistry of Carbohydrates:** definition, classification. Isomerism, optical isomerism, Structural presentation of monosaccharide's, The various chemical reactions of carbohydrates and their derivatives. Disaccharides and polysaccharides.
- 3) **Chemistry of Lipids:** definition, Classifications, properties , classifications. Fatty acids types and uses, Glycerides, Phospholipids, Glycolipids, Ecosanides, Steroids, Cholestrol, Lipoproteins, Amphipathic lipids and lipid bi layer.
- 4) **Chemistry of Amino acids and proteins:** definition of amino acids, Classification based on structure, requirement, metabolic fate, solubility, Physical properties of Amino acids, Chemical properties of amino acids. iso electric pH. Non standard amino acids.

Proteins: Definition, Structure, structural classification, Functional classification.

Peptide bonds and structural Motifs in protein such as A helix, B pleated sheets etc,

Reactions of proteins such as denaturation, heat coagulation, salting out, reaction with acids, reactions with alkali, precipitations by heavy metals, precipitations by organic solvents, precipitation by alkaloid reagents.

- 5) **Nucleotides and nucleic acids:** Nucleotides, Purines and Pyrimidines. Sugars in nucleotides, DNA structure, Coiling and packaging of DNA, Histones, Genes and chromosomes. RNA types and structure of RNA.
- 6) **Vitamins:** Fat soluble and water soluble vitamins, Uses of Vitamins, Deficiency disorders.
- 7) **Nutrition:** Diet, calculation of balanced diet, disorders of protein energy malnutrition.
- 8) **Water and electrolytes,** Acid Base balance: ECF, ICF, Intra cellular and extra cellular electrolytes. Dehydration.

Acidosis, alkalosis, Buffers, Means of maintaining pH.

## **Practical-Clinical Biochemistry**

- Laboratory safety : Fire, chemical, radiation ,handling of biological specimens, waste
- Disposal regulations, workplace hazardous.
- Specimen collection, identification, transport, delivery and preservation.
- Patient preparation for tests.
- Anticoagulants' and preservatives
- Regulations and precautions regarding transport of biological specimens
- Preparation of high quality water



- pH determination
- Preparation of buffers and determination of pH
- Measurement of radioactivity
- Practical's related to solvent extraction, Partition coefficient, Dialysis, Concentration,
- Desalting and Ultracentrifugation.
- Calibration of equipments and laboratory wares.
- Familiarization and usage of Colorimetry, spectrophotometry, fluorimetry,
- flame photometry, atomic absorption spectroscopy, nephelometry, osmometry,
- Chemiluminescence, ion selective electrodes, flowcytometry.
- Chromatography : - Paper, Thin layer, Gel filtration, Ion exchange, HPLC, GLC,
- Separation of various sugars, amino acids, lipids, drugs toxins etc. Urine amino gram.
- Electrophoresis: - Paper, Agarose gel, Cellulose acetate, PAGE, SDS-PAGE.

## Separation

- of serum proteins, lipoproteins, haemoglobin, globin chain and isoenzymes
- Tissue homogenization and cell disruption
- Cell fractionation methods
- Extraction of glycogen and its estimation
- Extraction of protein and its estimation
- Extraction of lipids and estimation of total lipids, glycolipid, phospholipids and cholesterol.
- Determination of saponification number and iodine number from oils
- Estimation of lactic acid and pyruvic acid
- Qualitative analysis of carbohydrate
- Detection of unknown sugars
- Qualitative analysis of proteins
- Isolation of DNA and RNA
- Estimation of DNA and RNA
- Agarose gel electrophoresis of DNA

## **PAPER:- 3 CLINICAL PATHOLOGY**

- Examination of Urine - Routine and Special tests
- Examination of Stool - Routine and Special tests
- Examination of Sputum - Routine and Special tests
- Semen examination - Routine and Special tests
- Examination of CSF - Routine and Special tests
- Examination of various body fluids-Pleural Fluid, Pericardial Fluid, Synovial Fluid, Ascetic Fluid
- Various methods of detecting HCG levels
- Structure and molecular organization of Chromosomes
- Identification of human chromosomes
- Karyotyping
- Direct chromosome preparation of Bone Marrow cells
- Culture techniques
- Banding techniques
- Sex Chromatin bodies
- Autoradiography of human chromosomes
- Chromosome Identification by image analysis and Quantitative cytochemistry
- Clinical Manifestations of chromosome disorders
- Anemia and other disorders of Erythropoiesis
- Disorders of Leucopoiesis
- Homeostasis & its investigations
- Investigations of Thrombotic tendency
- Laboratory control of Anticoagulant , Thrombotic and platelet therapy
- Collection and handling of Blood
- All Routine and special Hematological Investigations
- Blood and Bone Marrow preparations

- Leucoproliferative disorders with special references to Leukemia
- Automation in Hematology
- Cytochemistry of Leukemic cells
- Amniocentesis
- Bone marrow transplantation
- Application of different Microscopes
- Preparations of various Reagents and Stains used in Hematology
- Immunophenotyping
- Flowcytometry
- Molecular techniques in Hematology

## **Practical Clinical Pathology**

- Examination of Urine - Routine and Special tests
- Examination of Stool - Routine and Special tests
- Examination of Sputum - Routine and Special tests
- Semen examination - Routine and Special tests
- Examination of CSF - Routine and Special tests
- Examination of various body fluids-Pleural Fluid, Pericardial Fluid, Synovial Fluid, Ascetic Fluid
- Various methods of detecting HCG levels
- Structure and molecular organization of Chromosomes
- Identification of human chromosomes
- Karyotyping
- Direct chromosome preparation of Bone Marrow cells
- Culture techniques
- Banding techniques
- Sex Chromatin bodies
- Autoradiography of human chromosomes

- Chromosome Identification by image analysis and Quantitative cytochemistry
- Clinical Manifestations of chromosome disorders
- Organization of Histology Laboratory

## **PAPER:- 4 CLINICAL MICROBIOLOGY**

### **UNIT I**

#### **CLINICAL MICROBIOLOGY THEORY UNIT I GENERAL MICROBIOLOGY**

1. History and Pioneers in microbiology
2. Microscopy
3. Morphology of bacteria and other microorganism
4. Nomenclature and classification of microbes
5. Growth and nutrition of bacteria
6. Sterilization and disinfection
7. Bacterial toxins
8. Bacterial genetics
9. Antibacterial substances used in the treatment of infection and drug resistance in bacteria
10. Bacterial ecology-Normal flora of human body, Hospital environment, Air, Water and Milk

### **UNIT II IMMUNOLOGY**

#### **GENERAL MICROBIOLOGY**

1. Normal immune system
2. Innate immunity and acquired immunity
3. Antigens
4. Immunoglobulin
5. Complement
6. Antigen-Antibody reactions

7. Cell mediated immunity & humoral immunity
8. Hypersensitivity
9. Immunodeficiency
10. Auto-immunity

## **UNIT III**

### **SYSTEMIC BACTERIOLOGY**

1. Isolation, description and identification of bacteria
2. Staphylococcus and Micrococcus
3. Streptococcus
4. Neisseria
5. Corynebacterium
6. Bacillus: The Aerobic spore bearing bacilli
7. Clostridium: The anaerobic spore bearing bacilli
8. Enterobacteriaceae
9. Vibrios and Campylobacter
10. Haemophilus and Bordetella
11. Brucella
12. Mycobacteria
13. Actinomyces and Nocardia
14. Pseudomonas
15. Spirochaetes
16. Chlamydiae
17. Rickettsiae
18. Mycoplasma & Ureaplasma

## **UNIT IV**

### **VIROLOGY**

1. Classification of viruses
2. Morphology, Virus structure
3. Viral replication
4. Pathogenicity of viruses
5. Bacteriophages
6. Pox viruses
7. Herpes viruses
8. Arboviruses
9. Orthomyxovirus
10. paramyxoviruses
11. Enteroviruses: Polio & other enteric viruses
12. Hepatitis viruses
13. Rabies viruses
14. Human immunodeficiency viruses

## **UNIT V**

### **PARASITOLOGY**

Protozoan parasites of medical importance

Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodium,  
Toxoplasma, Pneumocystis Carinii

Helminths: All those medically important helminths belonging to Cestodes, Trematodes  
and Nematodes

Cestodes: Diphylobothrium, Taenia, Echinococcus, Hymenolepis,

Nematodes: Trichuris, Trichinella, Strongyloides, Ancylostoma, Ascaris, Enterobius, Filarial worms, Dracunculus medinensis, etc.

## **UNIT VI**

### **MYCOLOGY**

1. The morphology and reproduction in fungi
2. Classification of fungi
3. Opportinistic fungi
4. Superficial mycotic infections
5. Fungi causing subcutaneous mycoses
6. Fungi causing systemic infections
7. Laboratory diagnosis of fungal infections

## **UNIT VII**

### **CLINICAL MICRO BIOLOGY**

1. Laboratory diagnosis of Meningitis, Lower respiratory tract infection, Upper respiratory infection, Genital tract infection.
2. Gastroenteritis
3. Blood stream infection
4. Hospital acquired infection and Biomedical waste management

### **Practical**

#### **SKILLS TO ACQUIRE BACTERIOLOGY**

1. Aseptic practice in Lab and safety precautions
2. Washing and Sterilization of glasswares
3. Care and operation of microscopes viz. Dark ground, Phase contrast and Fluorescent microscope,(Electron microscope.
4. Operation and maintenance of Autoclave, Hot air oven, Distillation plants, Filters

like Sietz and Membrane and sterility test and Testing of disinfectant-Phenol coefficient test and its uses.

5. Care and maintenance of common laboratory equipments
6. Collection of specimens for Microbiological investigations
7. Preparations of stains viz. Grams, Alberts, Capsules, Spores, Ziehl Neelsons, etc and performing of staining
8. Preparation and pouring of media- Nutrient agar, Blood agar, Mac Conkey agar, Sugars, Kligler iron agar, Robertson's cooked meat, Lowenstein Jensen, Sabouraud's
9. Preparation of reagents-Oxidase, Kovac, etc
10. Identification of bacteria of medical importance upto species level(except Anaerobes which could be upto generic level)
11. Preparation of antibiotics discs: performance of Kirby Bauer, Stokes, etc
12. Disposal of contaminated materials
13. Quality control of media, reagents, etc.
14. Techniques for Anaerobiosi

## **IMMUNOLOGY**

1. Collection and preservation of serum.
2. Performance of common serological test
3. Immuno electrophoresis
4. ELISA
5. CD4
6. Skin test - Montoux test

## **MYCOLOGY**

1. Collection and processing of clinical specimens for fungi.
2. Special techniques like Wood lamp examination, hair baiting techniques, slide cultures.
3. Stoke cultures maintenance



## **PARASITOLOGY**

1. Examination of faeces for ova and cysts: Direct and Concentration method.
2. Egg counting techniques.
3. Examination of peripheral blood, Urine, CSF, and other fluids for parasites.
4. Permanent staining technique for parasites.

## **VIROLOGY**

1. Preparation and identification of CPE in various tissue cultures.
2. Serological test for viral infections
3. Handling of experiment animals and collection of various samples for evidence of viral infections in animals.
4. Laboratory diagnosis of AIDS
5. Laboratory diagnosis of Hepatitis
6. Laboratory diagnosis of Dengue
7. Safety measures

## 1<sup>ST</sup>. YEAR (Sem II)

### PAPER:-5 PHYSIOLOGY & NUTRITION

#### **Unit-I**

Digestion and absorption of carbohydrates, proteins, fats and nucleic acids. Physiology and biochemistry of respiration. Detoxification mechanisms generally taking place in human body. Body fluids.

#### **Unit-II**

Blood clotting, extrinsic and intrinsic pathways. Anticoagulants. Clot refracts. Acid base balance. Muscle contraction and relaxation sliding filament theory. Biochemical changes taking place after death of the animal.

#### **Unit-III**

Sources, functions and importance of macro and micro minerals. Balanced diets. Nutritional disorder namely obesity, ketosis, starvations, malnutrition and deficiency diseases.

#### **Unit-IV**

Specific dynamic effect, BMR, BMI and energy intake. Major in born errors of protein, fat and carbohydrate metabolism. Intrinsic disorders of red cells hemoglobin and porphyrins.

#### **Unit-V**

Gout and genetic defects in urate metabolism. Methods employed usually in protein quality evaluation. Nutritional experiments commonly done on laboratory animals. Recent advance techniques used in human nutrition studies.

## **Practical Physiology & Nutrition**

- Bleeding disorders – PT, APTT, TT, Fibrinogen
- Estimation of Calcium , Phosphorus, Magnesium, Manganese, Sodium , Potassium,
- Chloride, Iron , Copper, Iodine, Zinc, Protein bound iodine
- Agglutination reaction, Precipitation reaction, Immunodiffusion, Double diffusion
- technique, Immuno electrophoresis, Immunofixation, Migration inhibition factor, ELISA,
- Nephelometric immunoassays, Chemiluminescence immunoassays, Immunofluorescence,
- Western blotting and identification of blot by ELISA technique.
- Preparation of antisera and its standardization.

## **PAPER :- 6 BIOSTATISTICS & HOSPITAL MANAGEMENT**

### **Unit-I**

#### **Bio-statistics**

**Introduction and some basic concepts,** Sample and Population, Collection, classification and presentation of data, Measures of Central Tendency (Mean, Median, Mode), Measures of Dispersion— Average Deviation, Standard deviation, Binomial, poisson and Normal Distribution, skewness and kurtosis, Tests of significance, Correlation, Regression,  $\chi^2$  test, t and p test.

**Statistical definitions.** Random sampling. Testing of hypothesis. Statistical tools for collection, presentation and analysis of data relating to causes and incidence of diseases. Measures of variation. Frequency distribution.

## **Unit-II**

Concept of probability. Laws of probability. Probability distribution. Binomial, normal and chi-square distribution commonly used procedures of test of significance and estimation. Correlation and regression. Test of significance namely Z test, T test, Chi square test, F test. Analysis of variance.

## **Unit-III**

**Research statistics** pertaining to medical laboratory technology and testing the efficacy of manufacturing drugs medicines and injections or curbing and controlling specific diseases. Statistical analysis of instrumental data and comparison of various biological techniques used in hospitals.

### **1 Types of Research:**

- Basic or fundamental
- Applied
- Clinical Experimental

### **2 Qualification in Research Methodology**

- Open trials – Bias and safeguards against it.
- Double blind, Triple blind studies Cross over methods

### **3 Objectivity in Research Methodology**

- Instrumental quantification, rationales and fallacies
- Reproducibility
- Scoring methods – Safeguards against subjective bias. Records, Protocols and analysis

## 4 Special areas of research

- Clinical
- Experimental
- Histological & morphological
- Histochemical
- Genetic
- Epidemiologic studies

### Unit-IV

**Health care** – an overview. Functions of hospital administration, Modern techniques in hospital management. Challenges and strategies of hospital management. Administrative functions – planning, organizing, staffing, leading and controlling organizational structure, motivation and leadership. Designing health care organization.

### Unit-V

**Medical record.** House-keeping services. Laboratory performance. Management of biomedical waste. **Total patient care** – indoor and outdoor. Nursing and ambulance resources. Evaluation of hospital. services **Quality assurance.** Record reviews and medical audit.

### Recommended Books :

Methods in Bio-Statistics for medical students, Mahajan, B.K., Jaypee Brothers Medical Publishers, New Delhi.

### PAPER:- 7 CLINICAL HEMATOLOGY

1. Red Blood Cells :
  - a. Normal morphology count
  - b. Isolation from whole blood & count

- c. Effect on count & morphology of physiochemical parameters & the diseased state
  - d. Red cell anomalies & their relevance w.r.t. normal & diseased state
2. Blood Transfusion :
- a. Pre-requisitement & the complication of mis-matched transfusion.
  - b. Methods of blood matching
3. White blood cells & platelets;-
- a. Morphology count & methods of isolation
  - b. Effect on count & morphology of cell by the physiochemical parameters, diseased. State & the relevance of condition of the diseases
4. Anaemia's :
- a. Definition (in general) & courses
  - b. Types of anemia & their classification
  - c. Physiochemical, characteristic features & eterology of a plastic anemia, hemolytic, megaloblastic
  - d. Clinical features & diagnosis
5. Leukaemia
- a. Definition (in general) & heir etrology
  - b. Classification of leukaemia
  - c. FAB classification
  - d. Etiologies, physiochemical features of different type o leukaeia,s with reference to clinical states
  - e. Diagnosis of different types of leukaemias
6. Coagulation studies;
- a. General pathway (intrinsic & extrinsic)
  - b. Properties (physiochemical) mode of action of coagulation factors

- c. Platelet studies, platelet function tests (for different Coagulation factors) > Effect of promoters & inhibitors at diff steps in coagulation, their solution & mode of action.
- d. Diseases associated with coagulation disorders, their etiology & characteristics features.

## 7. Red Cell mass studies'

- a. Chemical method & radioactive methods
- b. Red Cell function studies
  - Anaemia and other disorders of Erythropoiesis
  - Disorders of Leucopoiesis
  - Haemostasis & its investigations
  - Investigations of Thrombotic tendency
  - Laboratory control of Anticoagulant , Thrombotic and platelet therapy
  - Collection and handling of Blood
  - All Routine and special Haematological Investigations
  - Blood and Bone Marrow preparations
  - Leucoproliferative disorders with special references to Leukaemias
  - Automation in Haematology
  - Cytochemistry of Leukaemic cells
  - Amniocentesis
  - Bone marrow transplantation
  - Application of different Microscopes
  - Preparations of various Reagents and Stains used in Haematology
  - Immunophenotyping

- Flowcytometry
- Molecular techniques in Haematology

## **Practical- Clinical Hematology**

- Haemopoiesis
- Anaemia and other disorders of Erythropoiesis
- Disorders of Leucopoiesis
- Haemostasis & its investigations
- Investigations of Thrombotic tendency
- Laboratory control of Anticoagulant , Thrombotic and platelet therapy
- Collection and handling of Blood
- All Routine and special Haematological Investigations
- Blood and Bone Marrow preparations
- Leucoproliferative disorders with special references to Leukaemias
- Automation in Haemtology
- Cytochemistry of Leukaemic cells
- Amniocentesis
- Bone marrow transplantation
- Application of different Microscopes
- Preparations of various Reagents and Stains used in Haematology
- Immunophenotyping
- Flowcytometry
- Molecular techniques in Haematology

## **Paper:- 8 ADVANCE INSTRUMENTATION & MAINTENANCE**

### **Unit-I**

Spectroscopy: Interaction of radiation wit matter, emission of radiation. Bear-Lambert relationship, components of a spectrophotometer. UV and vis spectrophotometer. Fluor



metric methods, atomic absorption spectroscopy. Application of different spectroscopic techniques.

## **Unit-II**

Principles of adsorption and partition chromatography. Absorption chromatography, liquid chromatography, Gas liquid chromatography, Ion exchange chromatography, Affinity chromatography and high pressure liquid chromatography. Application of chromatographic techniques in biology.

## **Unit-III**

Dialysis, electrophoresis, immune electrophoresis, isoelectric focusing, isotachopheresis, capillary electrophoresis. Application of electrophoresis in biology. Blot techniques – southern and northern techniques.

## **Unit-IV**

Centrifugation Preparative and analytical centrifuge, sedimentation analysis. Zonal and equilibrium density gradient. Ultracentrifuge. Light, phase contract, fluorescene and electron microscopy. Flame photometry. Analyzers.

## **Unit-V**

Radioisotopes, nature of radioactivity, type of radioactivity, radioactive decay. Units of radioactivity. Detection and measurement of radioactivity. Knowledge of proportional scintillation and gamma counters. Autoradiography. Biochemical uses of radio isotopes.

## **Unit VI INSTRUMENTATION**

1. Separation of DNA by Agarose Gel Electrophoresis
2. Separation of isoenzymes, lipoproteins by PAGE
3. Separation of amino acids by paper chromatography

4. Separation of amino acids & or carbohydrates by TLC
5. Determination of effect of inhibitor on  $K_m$  &  $V_{max}$  values
6. Estimation of proteins by Bradford's method
7. Estimation of proteins by Folin-Lowry's method
8. Scanning of absorption spectra of color formed in biochemical assay on single beam spectrophotometer.

## **Practical**

- Estimation of biochemistry parameter using Autoanalyzer, Semiautoanalyzer
- Scanning of absorption spectra of any amino acid on double beam spectrophotometer
- Determination of  $Na^+$  &  $K^+$  in blood serum using flame photometer
- Determination of pH of blood and arterial blood gas analysis.
- Estimation of various minerals using Atomic absorption spectrophotometer (AAS).
- Estimation of various hormones, tumor markers by using Chemiluminescence (CLIA) AND ELISA method.

## **Recommended Books:**

1. Biologist, S Guide to Principles and Techniques of Practical Biochemistry, K. Wilson and K.H. Goulding, ELBS edition.
2. Principles and Techniques of Biochemistry and Molecular Biology, K. Wilson and J. Walker, Cambridge University Press, Cambridge.
3. Introductory Practical Biochemistry, Sawhney, S.K. Singh, R. Narosa Publishing House, New Delhi.

**2<sup>ND</sup> YEAR (Sem III)**

**PAPER :- 1 LAB MANAGEMENT**

**Unit 1** Pathological clinics

Ethics of the pathological clinics

**Unit II**

Pathology laboratory,

Organization to a pathology laboratory under board of quality control.

**Unit III Development**

Personality development and patient relationship.

**Unit IV Reports writing**

Pathology reports writing

**Unit V: Computer application**

Computer application in pathological clinics.

**Unit VI : Accountancy**

Accountancy in clinical pathology

**Unit VIII Operation ethics**

Introduction Operation ethics

**Unit IX : Social ethics**

Introduction techniques Social ethics of pathology

## **Unit X: Instruments**

Proper handling to instruments

## **Unit XI: Administration of Laboratories**

Unit XII: Operation Hazardous compound

Chemical solvent poisons isotopes, explosives and Biological strains Pathological clinics  
E Ethics of the pathological clinics

Organization of a pathology laboratory under board of quality control Personality  
development and patient relationship

Pathology reports writing

Computer application in pathological clinics Accountancy in clinical pathology

Hospital Management Operation ethics

Social ethics of pathology Proper handling of instruments

## **Laboratory management and use of computer in laboratory.**

Laboratory safety, Personal management, Record keeping, Data analysis. Applications of  
computer in laboratory. Workload analysis

Finance: Budgeting, operational expenses, cost accounting, justification of budget.

Principles, Application and maintenance of Auto analyzers, Blood gas analyzers,  
Electrolyte analyzer, Chemiluminescence.

## **Reference Book**

1. Clinical Lab Management by Williams & Wilkins

## **PAPER :-2 Blood Transfusions & IMMUNOHEMATOLOGY**

**Unit I** Reception, labeling and recording of laboratory investigations Cleaning of glassware, pipettes, E.S.R. tubes and counting chambers Preparation of capillary pipette, distilled water, reagents, buffers

**Unit II** Collection of blood, preparation of blood smear, staining of blood and bone marrow smears.

**Unit III** Measurement of hemoglobin, counting of leucocytes, erythrocytes, platelets and reticulocytes. Recognition of blood cells in peripheral blood smears

**Unit IV** Determination of haematocrite and E.S.R., preparation of haemolysate and determination of alkali resistant hemoglobin, paper electrophoresis of hemoglobin. Test for sickle celling, bleeding time, coagulation time, prothrombin time, and kaolin cephalin clotting time.

**Unit V** Abo blood grouping and Rh typing

Performance of direct and indirect coombs test, red cell agglutination test (screening Paul bunnell test).

**Unit VI** Preparation for the demonstration of L.E. Cell phenomenon.

**Unit VII** Blood donor selection & screening

Blood collection and preservation, principal of clearing and preparing transfusion bottle and tubing sets – preparation and composition of anticoagulant – preservative solutions.

**Unit VIII** Transfusion reaction and their investigations

## **Immunohematology**

1. Blood & blood group antigens: General characteristics of ABO, Lewis, Rh, Mn & Xg antigens. Leucocyte & platelet & is antigens. Blood transfusion, Erythroblast sis fetails.
2. Molecular structure of hemoglobin. Genetic significance of Hemoglobin, structural variation
3. Chemical & biochemical characteristics of Hemoglobin biosynthesis.

### **1. Blood Grouping**

- Introduction
- Human Blood Group system
- ABO Subgroups
- Red Cell Antigen
- Natural Antibodies
- Rh. System
- Rh. Antigens & Rh Antibodies
- Hemolytic Diseases of New born & Prevention
- Principal of Blood grouping, antigen-antibody reaction.
- Agglutination, Haemag glutination, Condition required for antigen antibody reaction
- Blood grouping techniques-Cell grouping, Serum grouping
- Method for ABO grouping Slid & Tube Method Cell grouping Serum grouping Rh grouping by slide & tube method
- Difficulties in ABO grouping
- Rouleaux formation how it interfere with Blood grouping
- Auto agglutinins.
- Antiserum used in ABO test procedures, Anti-A, Anti-B, Anti-AB Antiserum
- Inheritance of the Blood groups;

- Control A & B Cells preparation Auto Control
- Medical applications of Blood groups

## 2. **Blood Transfusion**

- Principal & Practice of blood Transfusion
- Blood Transfusion service at District Level
- Guide lines for the use of Blood Appropriate use of Blood Quality Assurance
- Antilogous Blood Transfusion practices.
- Objectives of Quality Assurance in Blood Transfusion services, Standard operating procedures for usage, donation & storage of blood screening of donor compatibility testing, safety procurement of supplies.

## 3. **Blood Donation**

- Introduction
- Blood donor requirements
- Criteria for selection & rejection
- Medical history & personal details
- Self-exclusion
- Health checks before donating blood
- Screening for TTI

## 4. **Blood Collection**

- Blood collections packs
- Anticoagulants
- Taking & giving sets in Blood transfusion
- Techniques of collecting blood from a donor
- Instructions given to the donor after blood donation
- Adverse donor reaction

## 5. Testing Donor Blood

- Screening donor's blood for infectious agents –HIV, HCV, HBV, Trepanoma palladium, Plasmodium HTLV.
- Terially contaminated Blood

## 6. Blood Donor Records

- Blood donation record book
- Recording results.
- Blood donor card

## 7. Storage & Transport

- Storage of blood
- Changes in blood after storage
- Gas refrigerator
- Lay out of a blood bank ref refrigerator
- Transportation

## 8. Maintenance of Blood Bank Records

- Blood bank temperature sheet
- Blood bank stock sheet
- Blood transfusion request form.

## 9. Compatibility Testing

- Purpose
- Single tube compatibility techniques using AHG reagent
- Emergency compatibility testing
- Difficulties in cross matching
- Labeling & Issuing cross-matched blood



## 10. Blood Components

- Collection of blood components of fractional transfusion
- Platelets packed Red Cell Platelet rich Plasma, Platelets concentrate
- Preparation of concentrated (packed) Red Cells
- Techniques of preparation.

## 11. Blood Transfusion Reaction

- Investigation of a Transfusion reaction
- Hemolytic transfusion reaction
- Actions to take when transfusion reaction occurs.

## Practical Blood Transfusion

### Blood Bank Administration

- a. Record Keeping
  - b. Computerization in blood transfusion services.
  - c. Blood grouping ABO
  - d. PH typing various techniques.
  - e. Cross Matching**
  - f. Tube test
  - g. Slide Test
  - h. DU Test
  - i. Sub Grouping Test
- **Coomb's Test**
    - a. Direct comb's test
    - b. Indirect comb's test

- **Compatibility testing for blood transfusion cross matching test.**
  - a. 5% cell suspension and 10% cell suspensions.
  - b. HIV and AIDS demonstration
    - Haemopoiesis
    - Anaemia and other disorders of Erythropoiesis
    - Disorders of Leucopoiesis
    - Haemostasis & its investigations
    - Investigations of Thrombotic tendency
    - Laboratory control of Anticoagulant , Thrombotic and platelet therapy
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    - Blood and Bone Marrow preparations
    - Leucoproliferative disorders with special references to Leukaemias
    - Automation in Haemtology
    - Cytochemistry of Leukaemic cells
    - Amniocentesis
    - Bone marrow transplantation
    - Application of different Microscopes
    - Preparations of various Reagents and Stains used in Haematology
    - Immunophenotyping
    - Flowcytometry
    - Molecular techniques in Haematology

## **PRACTICAL**

1. Basic Hematological Techniques, Characteristic of good technician, Preparation of specimen collection material, Lab. Request from, Basic steps for drawing a blood specimen by vein puncture. Complication of vein puncture, Patient after care,

Specimen rejectin criteria for blood specimen, Hemolytic of blood, Blood collection by skin puncture (Capillary Blood), Arterial puncture, Deciding specimen types and selection of , Anticoagulant-EDTA, Citrate, Oxalate, Heparin, sodium fluoride., Separation of serum, Separation of plasma, Changes in blood on keeping, Maintenance of specimen identification, Transport of the specimen, Effect of storage on Blood Cell Morphology, Universal precautions.

2. 24 Basic requirements for hematology laboratory
3. Glassware's for Hematology
4. Equipments for Hematology
5. Anticoagulant vial preparation
6. Complete Blood Counts
7. Determination of Hemoglobin
8. TRBC Count by Hemocytometers
9. TLC by Hemocytometer
10. Differential Leukocyte count
11. Determination of Platelet Count.
12. Determination of ESR by win robes
13. Determination of ESR by Wintergreen's Method
14. Determination of PCV by Wintrobess
15. Erythrocyte Indices-MCV, MCH MCHC
16. Reticulocyte Count
17. Absolute Eosinophil Count
18. Morphology of Red Blood Cells
19. Blood grouping & Cross Matching
20. Reserves grouping
21. Antiglobintest
22. Rh. Typing
23. Donor Blood Connection Techniques

24 Laboratory in Good Criteria for Save Blood Collection, Quality control in Blood Banks. Risk assessment for AIDS and Serum hepatitis.

25 Basic knowledge of disease transmissible disease example HIV, Sera rum hepatitis B and C, VDRL, and Malariya

### **Paper:- 3. Histopathology**

**Introduction to Histology**, the cell, cell Organelles, nucleus, cell division, tissues, fresh & fixed tissues. Different types of Embedding Viz. Wax, Resin, and Cryostat etc. Basic Cytology

**Theory of Histopathology** Reception of specimens, Histopathology of Tumor cell, Histopathology of Liver Kidney Adrenal Ovary Testis.

**Fixation of tissue**, different kind of fixatives, sample fixative, compound fixative, formaldehyde, mercuric chloride, osmium, Picric acid, alcohols, other acids, formalin, buffered formalin, osmic acid, zenleer soln, he; ly's soln, cytological fixatives, nuclear fixatives, fixation of smear etc., decalcification, method of decalcification, assessment of decalcification, soln for decalcification.

**Processing of tissue**, dehydration, impregnation in the wax, manual and automatic tissue processor, gelatin embedding, celloidin embedding, double embedding, cytological fixatives, preparation of different smears, vaginal, sputum, membrane.

**Microtome, instrument**, principle, use in section cutting, parts and working of commonly used microtome, different kinds of microtome, rotary, base sledge, sliding, low temperature microtome, cryostat, microtome knives, homing and stropping knives.

**Section cutting o paraffin sections**, section preparation from frozen sections, fixing of tissue to slide, preparation of celloidin section and fixation. Staining techniques, natural dyes, synthetic dyes, basic and acidic dyes, haematoxylin staining, Pap, flicker & Conn,

methanamine silver nitrate, ziehl neelsen's stain, propylene glycol sudan technique, papanicolaou, harn's alum, Haematoxylin, acridine orange technique.

**Unit I:** Handling of fresh histological specimen (tissues)cryo/frozen sections of fresh and fixed tissues freeze drying Lipids identification and demonstration.

Micro organisms in tissues various staining technique for their demonstration and identification Nucleic acids DNA and RNA special stains and procedures  
Cytoplasm constituents and their demonstration.

Cervical cytology basis of detection of malignant and premalignant lesions Hermoral assessment with cytologic techniques and sex chroatis and pregnancy tests Cells and organs of immune system.

Immunoglobulin's antibodies and humoral immune response Allergy  
Rheumatological diseases and investigations.

## **Unit II Method of preparing stains**

Method of preparing stains & Fixatives. Theory of Tissue processing and embedding,  
Theory of H & E staining.

## **Unit III Use Microtome Tissues section**

Introduction, cutting Embedding and preparation of blocks Fixation of Tissue with DPX  
mount Theory of frozen section preparation.

## **Unit IV Preparation of smear**

Preparation of smear for Fine needle aspiration cytology Pap's smear theory and  
identification of cells in a normal vaginal smear.

## **Unit V Stool examination**

Normal abnormal constituent. Normal and abnormal constituent of Urine, Normal and

abnormal constituent of amniotic fluid Normal and abnormal constituent of Semem analysis.

## **Equipment used in histopathology, their merits and demerits and care to be taken:**

- a. Tissue processor
  - b. Microtome
  - c. Knife sharpener
  - d. Automatic slide strainer
  - e. Knives
  - f. Freezing microtome cryostat
  - g. Hot plate
  - h. Water bath
1. Decalcification-method, advantage and disadvantage of each method.
  2. Frozen section and Cryostat techniques, staining and mounting technique morbid anatomy
  3. Tissue processing-fixation Dehydrate, clearing impregnation in paraffin. Making of paraffin block and section cutting errors in section cutting and there correction.
  4. Preparation of different types special stains. Histo-chemical and Cyto-chemical techniques Immune Cytochemical staining.

## **Practical**

- Organisation of Histology Laboratory
- Histological equipments
- Reception and recording of tissue specimen
- Tissue processing and Microtomy including frozen
- Theory of staining
- Preparation and quality control of all routine and special stains used in istopathology
- All staining techniques and their interpretation

- Immunohistochemistry
- Molecular markers of malignant neoplasms
- Molecular techniques
- Immunofluorescent techniques
- Enzyme histochemistry
- Museum techniques
- Autopsy Techniques
- Automation in Histological Techniques
- Histopathology, Reception of specimens, Histopathology of Tumor cell
- Histopathology of Liver, Kidney, Adrenal, Ovary, Testies
- Method of preparing stains & Fixatives.
- Use of Microtome, Tissue section cutting
- Embedding and preparation of blocks
- Fixation of Tissue with DPX mount
- Reception and recording of tissue specimen
- Tissue processing and Microtomy including frozen
- Theory of staining
- Preparation and quality control of all routine and special stains used in Histopathology
- All staining techniques and their interpretation
- Immunohistochemistry
- Molecular markers of malignant neoplasms
- Molecular techniques
- Immunofluorescent techniques
- Enzyme histochemistry
- Museum techniques
- Autopsy Techniques
- Automation in Histological Techniques

**Paper :-4. Diagnostics Microbiology**

**Diagnostic Bacteriology**

Epidemiology of bacterial infections, Guidelines for the collection, Transport, Processing analysis, isolation of bacterial pathogens and reporting of cultures from specimens for bacterial infections.

Bacterial infections of respiratory tract.

Bacterial infections of gastro intestinal tract and food poisoning. Bacterial urinary tract infections.

Bacterial infections of genital tract and reproductive organs. Bacterial infections of central nervous system.

Skin and soft tissue infections. Bone and joint infections

Eye ear and sinus infections Cardiovascular infections Tissue samples for culture Anaerobic infections Zoonotic infections.

Infections associated with immunodeficiency and immune suppression Pyrexia of unknown origin.

**Bacterial immuno serology**

Enteric fever Streptococcal infections Syphilis

Rickettsial infections B rucellosis

Primary atypical pneumonia

New rapid serological diagnostic methods for bacterial infections.

**Antibiotics in laboratory Medicine** Antibiotics and mechanism of action MIC&MBC

Invitro susceptibility tests-Different methods Rapid methods of antibiotic susceptibility tests Antibiotic resistance mechanisms

Detection of methicillin resistant staphylococci

**Diagnostic parasitology**

Systematic study of following parasites (Geographical distribution, habitat, morphology



and life cycle, risk of infection, pathogenesis, laboratory diagnosis prophylaxis and serological diagnosis)

**Protozoa** – Intestinal amoeba, free living pathologic amoeba, giardia, trichomonas, balantidium, isospora, cryptosporidium, microspora, cyclospora Plasmodia, leishmania, trypanasoma, toxoplasma, babesia.

## **Helminthes** –

Cestodes – Taenia, Echinococcus, Diphylobothrium, Hymenolepsis, Multiceps Trematodes- Schistosoma, Fasciola, Fasciolepsis, Paragonimus, Clonorchis, Opisthorchis.

Nematodes- Ascaris, Hookworm, Trichuris, Enterobius, Strongyloides, Filaria, Trichinella, Toxocara, Dracunculus

Biological vectors

## **Mycology**

### **General Mycology** – Fungus – Classification

Fungal Structure & Morphology, Reproduction in fungi, Immunity to Fungal Infections.

Culture Media in Mycology , Stains in Mycology.

Normal fungal flora of human beings

### **Diagnostic Mycology**

Epidemiology, Pathogenesis, Laboratory Diagnosis of Fungal Infections.

Specimen collection, preservation, Transportation & Identification of Mycological Agent.

Biochemical tests for fungal identification

Anti fungal agents, invitro tests. Serological tests for mycotic infections. Use of laboratory animals in Mycology.

## **Practical**

### **Diagnostic Microbiology**

- Isolation, Characterization and identification of pathogens from various clinical specimens.
- Study of antibiotic sensitivity of common pathogens
- Common serological tests for the diagnosis of bacterial infections.
- Collection & transport of specimens
- Examination of stool for parasites.
- Examination of blood & bone marrow for parasites.
- Examination of other body fluids & biopsy specimens for parasites.
- Culture techniques for parasites.
- Serological diagnostic methods , skin test
- Collection & transport of specimens
- Examination of stool for parasites.
- Examination of blood & bone marrow for parasites.
- Examination of other body fluids & biopsy specimens for parasites.
- Culture techniques for parasites.
- Serological diagnostic methods , skin tests.

### **Diagnostic Mycology**

- Epidemiology, Pathogenesis, Laboratory Diagnosis of Fungal Infections.
- Specimen collection, preservation, Transportation & Identification of Mycological Agent.
- Biochemical tests for fungal identification
- Anti fungal agents, invitro tests.
- Serological tests for mycotic infections.
- Use of laboratory animals in Mycology.

- Typing of fungi
- Preparation of fungal antigens & their standardization
- Media & Stains preparation for Mycology, Diagnostic Methods in Mycotic Infections,
- Identification test in Mycology, Serological tests in Mycology Skin tests.
- Animal inoculation techniques

## 2<sup>ND</sup> YEAR (Sem IV)

### **Paper :- 5 Basic Cellular Pathology & Allied Technology**

**Unit I** Study of body tissues:-Epithelial tissues connective tissue including bone and cartilage muscular tissue

**Unit II** Study of various system:- Circulatory system, alimentary system, digestive system including liver, pancreas and gall bladder, Respiratory system

**Unit III** Microscopy-Working principle, maintenance and applications of various types of microscopes Dark ground microscope polarizing microscope phase contrast microscope Interference microscope U.V. light microscope micrometry

**Unit IV** Metachromasis and Met achromatic dyes Haematoxylin stain, its importance in histology

**Unit V** Stains cytological preparation with special emphasis on MGG, APANTICOLOU stains

**Unit VI** Special stains like PAS, Mucicarmine, Alcain blue, Schmorl, Acid phosphatase

**Unit VII** Study of body tissues-Nervous tissue glands epithelial and endocrine.

**Unit VIII** Study of body tissues-Nervous tissue glands epithelial and endocrine.

**Unit IX** Study of various systems-urinary systems system of endocrine glands reproductive system, nerve endings and organs of special senses.

**Unit X** Carbohydrates and amyloid-special stains and procedures.

**Unit XI** Connective tissues, trichrome staining and other special stains for muscle fibers elastic and reticulate fibers and collagen fibers.

**Unit XII** Principles of metal impregnation technique. Demonstration and identification of mineral and pigments. Cytological screening and quality control in cytology laboratory.

**No practical examination**

## **Paper:- 6 HEMATOLOGY & CLINICAL PATHOLOGY**

### **Red Blood Cells :**

- a. Normal morphology count
- b. Isolation from whole blood & count
- c. Effect on count & morphology of physiochemical parameters & the diseased state
- d. Red cell anomalies & their relevance w.r.t normal & diseased state

### **Blood Transfusion :**

- a. Pre-requisite & the complication of mis-matched transfusion
- b. Methods of blood matching

### **White blood cells & platelets;-**

- a. Morphology count & methods of isolation
- b. Effect on count & morphology of cell by the physiochemical parameters , diseased .  
State & the relevance of condition of the diseases

## **Anaemia's:**

- a. Definaation ( in general ) & courses
- b. Types of anaemia & their classification
- c. Physiochemical , characteristic features & eterology of a plastic anaemia, haemoloytic,megaloblastic
- d. Clinical features & diagnosis

## **Leukaemia**

- a. Definition (in general ) & their etrology
- b. Classification of leukaemia
- c. FAB classification
- d. Etiologies ,physiochemical features of different Type of leukaeia,s with reference to Clinical states
- e. Diagnosis of different types of leukemia

## **Coagulation studies ;**

- a. General pathways (intrinsic & extrinsic)
- b. Properties (physiochemical) mode of action of coagulation factors
- c. Platelet studies, platelet function tests (for different Coagulation factors) > Effect of promoters & inhibitors at diff steps in coagulation, their solution & mode of Action
- d. Diseases associated with coagulation disorders, their etrology & characteristics Features.

## **Red Cell mass studies ;**

- a. Chemical method & radioactive methods
- b. Red Cell function studies

## **Haemopoiesis**

- Anaemia and other disorders of Erythropoiesis
- Disorders of Leucopoiesis

- Haemostasis & its investigations
- Investigations of Thrombotic tendency
- Laboratory control of Anticoagulant , Thrombotic and platelet therapy
- collection and handling of Blood
- All Routine and special Haematological Investigations
- Blood and Bone Marrow preparations
- Leucoproliferative disorders with special references to Leukaemias
- Automation in Haemtology
- Cytochemistry of Leukaemic cells
- Amniocentesis
- Bone marrow transplantation
- Application of different Microscopes
- Preparations of various Reagents and Stains used in Haematology
- Immunophenotyping
- Flowcytometry
- Molecular techniques in Haematology
- Examination of Urine - Routine and Special tests
- Examination of Stool - Routine and Special tests
- Examination of Sputum - Routine and Special tests
- Semen examination - Routine and Special tests
- Examination of CSF - Routine and Special tests
- Examination of various body fluids-Pleural Fluid, Pericardial Fluid, Synovial fluid, Ascetic Fluid
- Various methods of detecting HCG levels
- Structure and molecular organization of Chromosomes
- Identification of human chromosomes
- Karyotyping
- Direct chromosome preparation of Bone Marrow cells
- Culture techniques

- Banding techniques
- Sex Chromatin bodies
- Autoradiography of human chromosomes
- Chromosome Identification by image analysis and Quantitative cytochemistry
- Clinical Manifestations of chromosome disorders

## **Practical Hematology & Clinical Pathology**

- Haemopoiesis
- Anaemia and other disorders of Erythropoiesis
- Disorders of Leucopoiesis
- Haemostasis & its investigations
- Investigations of Thrombotic tendency
- Laboratory control of Anticoagulant , Thrombotic and platelet therapy
- Collection and handling of Blood
- All Routine and special Haematological Investigations
- Blood and Bone Marrow preparations
- Leucoproliferative disorders with special references to Leukaemias
- Automation in Haematology
- Cytochemistry of Leukaemic cells
- Amniocentesis
- Bone marrow transplantation
- Application of different Microscopes
- Preparations of various Reagents and Stains used in Haematology
- Immunophenotyping
- Flowcytometry
- Molecular techniques in Haematology
- Examination of Urine - Routine and Special tests
- Examination of Stool - Routine and Special tests

- Examination of Sputum - Routine and Special tests
- Semen examination - Routine and Special tests
- Examination of CSF - Routine and Special tests
- Examination of various body fluids-Pleural Fluid, Pericardial Fluid, Synovial Fluid, Ascetic Fluid
- Various methods of detecting HCG levels
- Structure and molecular organization of Chromosomes
- Identification of human chromosomes
- Karyotyping
- Direct chromosome preparation of Bone Marrow cells
- Culture techniques
- Banding techniques
- Sex Chromatin bodies
- Autoradiography of human chromosomes
- Chromosome Identification by image analysis and Quantitative cytochemistry
- Clinical Manifestations of chromosome disorders

## **Paper :-7 Anatomy & Histo Technology**

**Laboratory equipment** its uses and maintenance Laboratory hazards and safety precautions

**Anatomy and physiology of human body:** General organization synopsis of all systems  
Cell organization and function: Structure & function of all cell organelles

**Skeletal system:** Structure and functions of all individual bones and joints movement of joints Skeletal muscles Cardiac muscles smooth muscles of upper arm & anterior compartment of thigh ( their name attachment function and nerve supply)



**Blood :** Functions of blood, composition of blood plasma & its functions; Blood clotting (mechanism clotting factors) Morphology of red blood cells, their function and development Hemoglobin anemia; WBC classification development & functions; platelets: morphology & functions; Blood groups, blood transfusion and transfusion reactions.

Reception recording and labeling of histology specimens Fixation and various fixatives

Processing of histological tissues for paraffin embedding Embedding and embedding media

## **Decalcification various methods**

Introduction to exfoliative cytology with special emphasis on female tract(PAP smear, cone biopsy)

Solvents mordents accelerators and accentuates

Microtome's various types their working principle and maintenance Microtome's Knives and Knife sharpening

Practical section cutting faults and remedies

Routine staining procedures mounting and mounting media Dye chemistry theory and practice of staining

Use of controls in various staining procedures

Collection processing and staining of cytological specimen

Tissue requiring special treatment i.e. eye ball Bone marrow biopsy under calcified bones. Neuropathology techniques

Enzyme histochemistry demonstrations of phosphates dehydrogenises oxides and peroxides etc.

**Electron microscope** working principle components and allied techniques for electron microscopy ultra-microtome Museum techniques

Aspiration cytology principles indications and utility of the technique with special emphasis on role of cytotechnician in FNAC clinics

Infection and immune system Cancer Immunology

Tissue typing for kidney transplant

## **Practical Anatomy & Histo Technology**

- Practical: demonstration of section of male and female pelvis with organs in situ
- Histology of testis, vas deferens, epididymis, prostate, uterus, fallopian tubes, ovary
- Radiographs of pelvis – hysterosalpingogram
- Histology of thin and thick skin
- Demonstration and histology of eyeball
- Histology of cornea & retina
- Organisation of Histology Laboratory
- Histological equipments
- Reception and recording of tissue specimen
- Tissue processing and Microtomy including frozen
- Theory of staining
- Preparation and quality control of all routine and special stains used in
- Histopathology
- All staining techniques and their interpretation
- Immunohistochemistry
- Molecular markers of malignant neoplasms
- Molecular techniques
- Immunofluorescent techniques
- Enzyme histochemistry
- Museum techniques
- Autopsy Techniques
- Automation in Histological Techniques

## **Paper:- 8 PATHOLOGY, TERMINOLOGY & CYTOLOGY**

### **Unit I**

Introductory Pathology: Cellular adaptation and cell death; inflammation and repair; infection; circulatory disorders; immune defense; genetics of disease; neoplasia. Cell injury and adaptation : Atrophy, hypertrophy, metaphase, hyperplasia, classification of tumors, premalignant lesion, Types of inflammation & system manifestations of inflammation Disorders of vascular flow & shock (Brief introduction) ; Oedema,hyperemia or congestion, thromboses, embolism, infarction shock, ischemia, Over hydration, Dehydration , The Response to infection ; Categories of infectious agents, host barriers to infection, how disease is caused , inflammatory response to infectious agents Hematopoietic and Lymphoid System : hemorrhage, various type of Anaemia, leucopenia, leucocytosis, bleeding disorders coagulation mechanism.

### **Unit II**

#### **Fundamentals of Medical Terminology :**

- Word Roots
- Prefix
- Suffix
- Abbreviations & Symbols
- Gastro intestinal
- Chelecystitis
- Cholelithiasis
- Appendicitis
- Intestinal Obstruction
- Hernia
- Peritonitis

## **Gastro copy : Endoscopy, Laparotomy, laparoscopy . Common Diseases & Procedures**

- Respiratory
- Tuberculosis
- Bronchial Asthma
- Respiratory Failure
- Pulmonary Embolism
- Pneumonia

Bronchoscope, Pulmonary Function test, Cardio-Pulmonary Resuscitation.

## **Unit III**

Circulatory Hypertension

Coronary Artery Disease Arrhythmias

Cardiac Arrest

Shock, Deep Vein thrombosis (DVT) , ECG, 2D Echo Cardiogram, Coronary Angiography, Cardiac Catheterization, Stress test, Pacemaker.

Renal

Nephrotic Syndrome Urinary Tract Infection Renal /Bladder Stones

Intravenous Pyelography, Cystoscopy, Urinalysis, Hemodialysis, Peritoneal Dialysis

Reproductive

Female - breast cancer /Self Examination

Menstrual Disorders, Dysmenorrhea, Premenstrual Syndrome ( PMS) , Menorrhagia

## Ovarian

Cyst, Fibroids, Malignancy, Infertility Mammography, Ultra Sound, Laparoscopy, IV F, Tubectomy,

## D& C

Male - Prostate Enlargement, Hydrocele, Impotence, T transurethral Resection of Prostate (TURP)

## Nervous

Stroke (Cerebro Vascular Accident) Brain Tumor

Brain Injuries Spinal Cord Injuries

Lumbar Puncture, Myelography, CT Scan, MRI, EEG, EMG

## Oncology

Investigations, Tumor markers, RECIST Criteria for response evaluation

## **Cytology**

Handling of fresh histological specimen (tissues) cryo/frozen sections of fresh and fixed tissues, freeze drying Lipids identification and demonstration

Micro-organisms in tissues-various staining technique for their demonstration and identification Nucleic acids, DNA and RNA special stains and procedures

Cytoplasmic constituents and their demonstration.

Cervical cytology-basis of detection of malignant and premalignant lesions.

Humoral assessment with cytologic techniques and sex chromatin and pregnancy test.

Cells and organs of immune system

Immunoglobulins, antibodies and humoral immune response Allergy

Rheumatologic diseases and investigations.

Tissues requiring special treatment i.e. eye ball Bone marrow biopsy under calcified

bones. Neuropathology techniques

Enzyme histochemistry demonstrations of phosphatases dehydrogenases oxidases and peroxidases etc. Electron microscope working principles components and allied techniques for electron microscopy ultra-microtomy Museum techniques

Aspiration cytology principles indications and utility of the techniques with special emphasis on role of cytotechnician in FNAC clinics

Infection and immune system Caner Immunology

Tissue typing for kidney transplant

## **Practical cytology**

- Morphology and Physiology of cell
- Cytology of
  - Female genital Tract
  - Urinary Tract
  - Gastrointestinal Tract
  - Respiratory Tract
  - Effusions
  - Miscellaneous Fluids
- Collection, Preservation, Fixation and Processing of various Cytological Specimen
- Preparation and Quality control of various stains and reagents used in cytology
- All routine and special Staining techniques in cytology
- FNAC
- Immunocytochemistry
- Flowcytometry
- Automation in Cytology

## **Dissertation**

### **a. Eligibility to be a guide**

Shall be a full time teacher in the college or institution he or she is working.

➤ **Viva- voce: -**

➤ **ETHICS IN M. Voc. MLT PATHOLOGY TECHNOLOGY**

**Introduction:** With the advances in science and technology and the increasing needs of the patient, their families and community, there is a concern for the health of the community as a whole. There is a shift to greater accountability to the society. It is therefore absolutely necessary for each and every one involved in the health care delivery to prepare them to deal with these problems. Technicians like the other professionals are confronted with many ethical problems.

Standards of professional conduct for technicians are necessary in the public interest to ensure an efficient laboratory service. Every technician should not only be willingly to play his part in giving such a service, but should also avoid any act or omission which would prejudice the giving of the services or impair confidence, in respect, for technician as a body.

To accomplish this and develop human values, it is desired that all the students undergo ethical sensitization by lectures or discussion on ethical issues.

## **Introduction to ethics-**

What is ethics?

General introduction to Code of Laboratory Ethics

How to form a value system in one's personal and professional life? International code of ethics

**Ethics of the individual-** Technician relation to his job Technician in relation to his trade  
Technician in relation to medical profession Technician in relation to his profession.

## **Professional Ethics-**

Code of conduct

Confidentiality

Fair trade practice

Handling of prescription

Mal practice and Negligence Professional vigilance

## **Research Ethics-**

Animal and experimental research/ humanness Human experimentation

Human volunteer research - informed consent Clinical trials

Gathering all scientific factors Gathering all value factors

Identifying areas of value – conflict, setting priorities

Working out criteria towards decision

ICMR/ CPCSEA/ INSA Guidelines for human / animal experimentation



**Recommended reading**

- Francis C.M., Medical Ethics, I Edition, 1993, Jay pee Brothers, New Delhi p189.
- Good Clinical Practices: GOI Guidelines for clinical trials on Pharmaceutical Products in India ([www.edsco.nic.in](http://www.edsco.nic.in))
- INSA Guidelines for care and use of Animals in Research – 2000.
- CPCSEA Guidelines 2001([www.cpcsea.org](http://www.cpcsea.org)).
- Ethical Guidelines for Biomedical Research on Human Subjects, 2000, ICMR, New Delhi

**ANNEXURE-I CATEGORIES OF BIO-MEDICAL WASTE**

	<b>Waste Category ** Type</b>	<b>Treatment a Disposal</b>
		<b>** Options</b>
<b>Category No. 1</b>	<b>Human Anatomical Waste:</b>  (human tissues, organs, body parts)	<b>Incineration deep burial</b>
<b>Category No. 2</b>	<b>Animal Waste:</b>  (animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals colleges, discharge form hospitals, animal houses)	<b>Incineration deep burial</b>

<p><b>Category No. 3</b></p>	<p><b>Microbiology &amp; Biotechnology Waste: (wastes from laboratory cultures, stocks or specimens or micro-organisms live or attenuated vaccines, human and animal</b></p> <p><b>Cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures)</b></p>	<p><b>Local autoclaving / micro waving / incineration.</b></p>
<p><b>Category No. 4</b></p>	<p><b>Waste sharps:</b></p> <p><b>(Needles, syringes, scalpels, blades, glass, etc, that may cause puncture and cuts. This includes both used and unused sharps)</b></p>	<p><b>Disinfection (chemical treatment / autoclaving / micro –waving and mutilation / shredding</b></p>
<p><b>Category No. 5</b></p>	<p><b>Discarded Medicines and Cytotoxic drugs:</b></p> <p><b>(wastes comprising of outdated, contaminated and discarded medicines)</b></p>	<p><b>Incineration / destruction and drugs disposal in secured landfills.</b></p>

<p><b>Category No. 6</b></p>	<p><b>** Solid Waste:</b>                   (Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, Eners, beddings, other material contaminated with blood)</p>	<p><b>Incineration</b>   <b>Autoclaving / micro waving</b></p>
<p><b>Category No. 7</b></p>	<p><b>Solid Waste:</b>                   (Wastes generated form disposable items other than the waste ** sharps such as tubings, catheters, intravenous sets, etc)</p>	<p><b>Disinfection by chemical treatment, autoclaving / micro-waving and mutilation / shredding</b></p>
<p><b>Category No. 8</b></p>	<p><b>Liquid Waste:</b>                   (Waste generated from laboratory and washing, cleaning, housekeeping and disinfecting activities)</p>	<p><b>Disinfection by chemical treatment and discharge into drains</b></p>
<p><b>Category No. 9</b></p>	<p><b>Incineration Ash:</b>                   (Ash from incineration of any biomedical waste)</p>	<p><b>Disposal in municipal landfill</b></p>